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IS 1248-5 (2003): Direct Acting Indicating Analogue Electrical Measuring Instruments and Their Accessories, Part 5: Phase Meters, Power Factor Meters and Synchroscopes [ETD 12: Measuring Equipment for Basic Electrical Quantities]



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“Knowledge is such a treasure which cannot be stolen”

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भारतीय मानक

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भाग 5 फेज मीटरों, पावर फैक्टर मीटरों तथा सिन्क्रोस्कोप की विशेष अपेक्षाएँ

(तीसरा पुनरीक्षण)

Indian Standard

**DIRECT ACTING INDICATING ANALOGUE
ELECTRICAL MEASURING INSTRUMENTS AND
THEIR ACCESSORIES**

**PART 5 SPECIAL REQUIREMENTS FOR PHASE METERS, POWER FACTOR
METERS AND SYNCHROSCOPES**

(Third Revision)

ICS 17.220.20

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

**AMENDMENT NO. 1 AUGUST 2007
TO
IS 1248 (PART 5) : 2003 DIRECT ACTING
INDICATING ANALOGUE ELECTRICAL
MEASURING INSTRUMENTS AND
THEIR ACCESSORIES**

**PART 5 SPECIAL REQUIREMENTS FOR PHASE
METERS, POWER FACTOR METERS
AND SYNCHROSCOPES**

(Third Revision)

(Page 2, Table 2, col 4) — Substitute '5 7 3', '5 8 2', '5 8 3', and '5 8 4' for '3 7 3', '3 8 2', '3 8 3', and '3 8 4' respectively.

(Page 3, Table 2, col 4) — Substitute '5 5', '5 9 3', '5 9 4', '5 9 5', and '5 12 2' for '3 5', '3 9 3', '3 9 4', '3 9 5', and '3 12 2' respectively.

(Page 4, clause 7.4.1, first para) — Substitute '6.6' for '5.6'.

(Page 4, clause 7.4.2, first para) — Substitute '6.4' for '5.4'.

(Page 4, clause 7.6, first para) — Substitute '6.9' for '5.9'.

FOREWORD

This Indian Standard (Part 5) (Third Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Measuring Equipment for Basic Electrical Quantities Sectional Committee had been approved by the Electrotechnical Division Council.

This standard covers the special requirements for phase meters, power factor meters and synchrosopes. This standard was first published in 1958 and was revised in 1968 and in 1983.

This standard is one of a series of nine Indian Standards on direct acting indicating analogue electrical measuring instruments and their accessories. The other parts are as follows:

- (Part 1) : 2003 Definitions and general requirements (*fourth revision*)
- (Part 2) : 2003 Special requirements for ammeters and voltmeters (*third revision*)
- (Part 3) : 2003 Special requirements for wattmeters and varmeters (*third revision*)
- (Part 4) : 2003 Special requirements for frequency meters (*third revision*)
- (Part 6) : 2003 Special requirements for ohmmeters (impedance meters) and conductance meters (*third revision*)
- (Part 7) : 2003 Special requirements for multi-function instruments (*third revision*)
- (Part 8) : 2003 Special requirements for accessories (*third revision*)
- (Part 9) : 2003 Test methods (*third revision*)

In preparation of this standard, assistance has been derived from IEC 60051-5 (1985) 'Direct acting indicating analogue electrical measuring instruments and their accessories: Part 5 Special requirements for phase meters, power factor meters and synchrosopes (fourth edition)', issued by the International Electrotechnical Commission (IEC).

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

DIRECT ACTING INDICATING ANALOGUE ELECTRICAL MEASURING INSTRUMENTS AND THEIR ACCESSORIES

PART 5 SPECIAL REQUIREMENTS FOR PHASE METERS, POWER FACTOR METERS AND SYNCHROSCOPES

*(Third Revision)***1 SCOPE**

1.1 This standard (Part 5) covers direct acting indicating analogue phase meters, power factor meters and synchroscopes.

1.2 This part also applies to non-interchangeable accessories as defined in 2.1.15.3 of IS 1248 (Part 1) used with phase meters, power factor meters and synchroscopes.

1.3 This part also applies to a phase meters or power factor meters whose scale marks do not correspond directly to its electrical input quantity, provided that the relationship between them is known.

2 REFERENCES

2.1 The following standards are necessary adjuncts to this standard:

<i>IS No.</i>	<i>Title</i>
1248	Direct acting indicating analogue electrical measuring instruments and their accessories:
(Part 1) : 2003	Definitions and general requirements (<i>fourth revision</i>)
(Part 9) : 2003	Test methods (<i>third revision</i>)

3 DEFINITIONS

3.1 The provisions of 3 of IS 1248 (Part 1) shall apply.

4 DESCRIPTION, CLASSIFICATION AND COMPLIANCE**4.1 Description**

Phase meters, power factor meters and synchroscopes shall be described according to their method of operation as given in 3.2 of IS 1248 (Part 1).

4.2 Classification

Phase meters, power factor meters and synchroscopes shall be classified in one of the accuracy classes denoted by the following class indices :

0.1, 0.2, 0.3, 0.5, 1, 1.5, 2, 2.5, 3 and 5.

4.3 Compliance with the Requirements of this Standard

The provisions of 4.3 of IS 1248 (Part 1) shall be applicable.

5 REFERENCE CONDITIONS AND INTRINSIC ERRORS**5.1 Reference Conditions**

5.1.1 The reference values of the influence quantities shall be as given in Table 1 of IS 1248 (Part 1) and Table 1.

5.1.2 The provisions of 5.1.2 of IS 1248 (Part 1) shall apply.

5.1.3 Reference conditions different from those given in Table 1 of IS 1248 (Part 1) and Table 1 may be specified, but they shall then be marked in accordance with 9 of IS 1248 (Part 1).

5.2 Limits of Intrinsic Error, Fiducial Value

The provisions of 5.2 of IS 1248 (Part 1) shall apply.

For a synchroscope, the accuracy requirements apply only at the synchronizing mark.

5.2.1 Correspondence Between Intrinsic Error and Accuracy Class

The provisions of 5.2.1 of IS 1248 (Part 1) shall apply.

5.2.2 Fiducial Value

The fiducial value corresponds to 90 electrical degrees. The class index is marked using Symbol E-1 given in Table 3 of IS 1248 (Part 1) [see 9 of IS 1248 (Part 1)].

6 NOMINAL RANGE OF USE AND VARIATIONS**6.1 Nominal Range of Use**

The provisions of 6.1 of IS 1248 (Part 1) and Table 2.

**Table 1 Reference Conditions and Tolerances, Additional to those Given in
Table 1 of IS 1248 (Part 1) for Testing Purposes
(Clause 5.1.1)**

SI No.	Influence Quantity	Reference Conditions Unless Otherwise Marked	Tolerance Permitted for Testing Purposes, Applicable for a Single Reference Value (see Note 1)
(1)	(2)	(3)	(4)
i)	Voltage component of the measured quantity	Rated voltage or any voltage within the reference range, if any	± 2 percent of the rated value
ii)	Current component of the measured quantity	40 percent to 100 percent of rated current	—
iii)	Phase balance (for polyphase instruments)	Symmetrical voltages and currents	(see Note 2)
iv)	Frequency of current and voltage components of the measured quantity at reference frequency, 45 Hz to 65 Hz	a) Instruments using phase shifting devices b) Other instruments	± 0.1 percent of the reference frequency ± 2 percent of the reference frequency

NOTES

1 This tolerance applies when a single reference value is specified in this table or is marked by the manufacturer. For a reference range no tolerance is allowed.

2 Each of the voltages (between any two lines or between line and neutral) shall not differ by more than 1 percent from the average of the voltages (line-to-line or line-to-neutral) of the system. Each of the currents in the phases shall not differ by more than 1 percent from the average of the currents. The angles between each of the currents and the corresponding phase-to-neutral voltages shall not differ by more than 2° from the average of the angles.

**Table 2 Limits of the Nominal Range of Use and Permissible Variations Additional to those Given in Table 2 of IS 1248 (Part 1)
(Clause 6.1)**

Influence Quantity		Limits of the Nominal Range of the Use Unless Otherwise Marked		Permissible Variation Expressed as a Percentage of the Class Index	For the Recommended Test, Ref to Cl of IS 1248 (Part 9)
(1)		(2)		(3)	(4)
Distortion of voltage and/or current components of the measured quantity	Distortion factor	5 percent		100 percent	3.7.3
	Peak factor (see Note 1)	1.....3 (see Note2)		Under consideration	
Current component of the measured quantity		20 percent120 percent of rated current		100 percent	Under consideration
Frequency of current and voltage components of the measured quantity		Instruments using phase shifting devices	Reference frequency ± 1 percent or lower limit of reference range -1 percent and upper limit of reference range $+1$ percent	100 percent	3.8.2
		Other instruments	Reference frequency ± 10 percent or lower limit of reference range -10 percent and upper limit of reference range $+10$ percent		3.8.3 3.8.4

Table 2 (Concluded)

Influence Quantity	Limits of the Nominal Range of the Use Unless Otherwise Marked	Permissible Variation Expressed as a Percentage of the Class Index			For the Recommended Test, Ref to Cl of IS 1248 (Part 9)
(1)	(2)	(3)			(4)
Magnetic field of external origin	0.4 kA/m		Class indices 0.3 and smaller	Class indices 0.5 and greater	3.5
		Electrodynamic instruments, if not astatic and/or not having a magnetic screen	3 percent of the fiducial value (see Note 3)	6 percent of the fiducial value (see Note 3)	
		Ferrodynamic instruments, if not astatic and/or not having a magnetic screen	1.5 percent of the fiducial value (see Note 3)	3 percent of the fiducial value (see Note 3)	
		All other instruments	0.75 percent of the fiducial value (see Note 3)	1.5 percent of the fiducial value (see Note 3)	
Voltage component of the measured quantity	Rated voltage ± 15 percent or lower limit of reference range – 15 percent and upper limit of reference range +15 percent	100			3.9.3 3.9.4 3.9.5
Phase balance (for polyphase instruments)	Disconnection of one current component of the measured quantity	200			3.12.2

NOTES

1 For instruments having electronic devices in their measuring circuits.

2 The permissible variation due to a peak factor of other than $\sqrt{2}$ (corresponding to sine wave) is included in the permissible variation due to distortion of the measured quantity

For instruments having a peak factor capability greater than 3, the manufacturer shall state :

- The peak factor producing a variation of 100 percent of the class index.
- The upper and lower limits of the frequency response (band width) to 0.707 times the indication at the reference frequency
- The effective maximum rate of change of internal instruments a.c. amplifier response (slew rate), expressed in volts per second, using appropriate S.I. prefixes.

3 Not as a percentage of the class index.

6.2 Limits of Variations

See IS 1248 (Part 1) and Table 2.

6.3 Conditions for the Determination of Variations

The provisions of 6.3 of IS 1248 (Part 1) shall apply.

7 FURTHER ELECTRICAL AND MECHANICAL REQUIREMENTS

7.1 Voltage Tests, Insulation Test and Other Safety Requirements

The provisions of 7.1 of IS 1248 (Part 1) shall apply.

7.2 Damping

The requirements of 7.2 of IS 1248 (Part 1) do not apply to phase meters, power factor meters and synchrosopes but applies to phase meters and power factor meters which have mechanical zero setting.

7.3 Self-Heating

The provisions of 7.3 of IS 1248 (Part 1) shall apply. However, the requirements of IS 1248 (Part 1) do not apply to synchrosopes.

7.4 Permissible Overloads

7.4.1 Continuous Overload

For the test method, *see* 5.6 of IS 1248 (Part 9).

All phase meters and power factor meters, together with their non-interchangeable accessory(ies), if any, except for instruments fitted with a non-locking switch, shall be subjected to a continuous overload of 120 percent of the rated value for all current circuits simultaneously for a period of 2 h.

After having cooled to the reference temperature, the instrument together with its non-interchangeable accessory(ies), if any, shall comply with its accuracy requirements but without repeating the overload.

The continuous overload test shall be carried out under reference conditions except for current.

The requirement for continuous overload does not apply to synchrosopes.

7.4.2 Overload of Short Duration

For the test method, *see* 5.4 of IS 1248 (Part 9). All phase meters, power factor meters and synchrosopes, together with their non-interchangeable accessory(ies), if any, shall be subjected to overloads of short duration.

However, these requirements do not apply to instruments whose scale marks do not correspond directly to their electrical input quantities (but not excluding instruments intended to be used with [an instrument transformer(s)]).

7.4.2.1 The value of current and voltage for the overloads of short duration shall be the product of the relevant factor given in Table 3 and the rated value of voltage or the upper limit of the nominal range of use for current unless other values are stated by the manufacturer.

The overloads shall be applied separately to each input circuit.

7.4.2.2 The full duration of each overload shall be applied except when an automatic cut-out (fuse) fitted to the instrument has interrupted the circuit in less than the time specified in Table 3.

The automatic cut-out shall be re-set (or the fuse replaced) before the application of the next overload.

7.4.2.3 After having been subjected to the overloads of short duration and after having cooled to the reference temperature, phase meters, power factor meters and synchrosopes, together with their non-interchangeable accessory(ies), if any, shall comply with their accuracy requirements; however, the overloads shall not be repeated.

7.5 Limiting Values of Temperature

The provisions of 7.5 of IS 1248 (Part 1) shall apply.

7.6 Deviation from Zero

For the test method, *see* 5.9 of IS 1248 (Part 9).

7.6.1 If a phase meter or a power factor meter has a setting mark (zero position mark) on the scale, it shall be tested for return to that mark when de-energized.

The test shall be carried out under reference conditions.

7.6.2 After a period of energization of 30 s at the upper limit of the measuring range, the deviation of the index from the setting mark (zero position mark), expressed as a percentage of the scale length, shall not exceed a value corresponding to 50 percent of the class index.

7.6.3 This requirement does not apply to synchrosopes.

7.7 Special Requirements for Synchrosopes

7.7.1 Synchrosopes shall have two separate input circuits, with no conductive connection between them.

7.7.2 For polyphase synchrosopes, the index shall be rotating in the correct direction when the difference between the frequencies applied to the two input circuits has been reduced to 1.5 Hz, one of the frequencies, being the reference frequency or any frequency within the reference range for frequency (if any).

For single phase synchrosopes, the value of 1.5 Hz is changed to 1 Hz.

7.7.3 For polyphase synchrosopes, for any constant frequency difference not exceeding 1.5 Hz, the rate of rotation of the index shall be substantially uniform as judged visually. For single phase synchrosopes, the value of 1.5 Hz is changed to 1 Hz.

7.7.4 Under reference conditions, but with one or both circuits disconnected, the index shall not indicate, at any time, within an angle of 30° on either side of the synchronizing mark. This requirement also applies if the disconnected circuit(s) remain connected to the secondary of the instrument transformer(s) with which it (they) is (are) normally associated, the disconnection being achieved on the primary of the transformer(s).

8 CONSTRUCTIONAL REQUIREMENTS

8.1 The provisions of 8.1 of IS 1248 (Part 1) is not applicable.

8.2 The provisions of 8.2 of IS 1248 (Part 1) is not applicable.

8.3 The provisions of 8.3 of IS 1248 (Part 1) is not applicable.

Table 3 Overloads of Short Duration*(Clauses 7.4.2.1 and 7.4.2.2)*

Measuring Circuit (1)	Overload Factor (2)	Number of Overloads (3)	Duration of Each Overload (4)	Interval Between Successive Overloads (5)
Class indices 0.5 and smaller				
Current circuit	2	5	1	15
Voltage circuit	2			
Class indices 1 and greater				
Current circuit	10	9	0.5	60
Voltage circuit	2			
Current circuit	10	1	5	—
Voltage circuit	2			
NOTE — Where two series of tests are specified, they shall both be carried out, in the order given.				

NOTE — Where two series of tests are specified, they shall both be carried out, in the order given.

8.4 Preferred Values

The rated values for phase meters, power factor meters and synchrosopes shall be the subject of agreement between the manufacturer and the user.

8.5 Adjusters, Mechanical and/or Electrical

The provisions of 8.5 of IS 1248 (Part 1) shall apply.

8.5.1 Zero Adjuster(s)

8.5.1.1 Phase meters and power factor meters having a mechanical zero position on the scale shall have a setting mark (zero position mark) at that position.

8.5.1.2 Phase meters and power factor meters not having a determinate mechanical zero or having a mechanical zero which is outside the scale shall not be provided with an accessible zero adjuster.

8.5.1.3 This requirement does not apply to synchrosopes.

8.6 Effects of Vibration and Shock

The provisions of 8.6 of IS 1248 (Part 1) shall apply.

9 INFORMATION, GENERAL MARKINGS AND SYMBOLS**9.1 Information**

The provisions of 9.1 of IS 1248 (Part 1) shall apply.

9.1.1 If an instrument is provided with a phase shifting device, this shall be stated as required by items (m) and (z) 9.1 in IS 1248 (Part 1).

9.2 The provisions of 9.2 of IS 1248 (Part 1) shall apply.

9.3 The provisions of 9.3 of IS 1248 (Part 1) shall apply.

10 MARKINGS AND SYMBOLS FOR TERMINALS

The provisions of 10 of IS 1248 (Part 1) shall apply,

11 TESTS TO PROVE COMPLIANCE WITH THIS STANDARD

The provisions of 10 of IS 1248 (Part 1) shall apply.

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